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Editors

Ricard W. Jensen
Texas Water Resources Institute,
Texas A&M University

Russell W. Kiesling
Galveston Bay National Estuary Program

and

Frank S. Shipley
Galveston Bay National Estuary Program

The Galveston Bay National Estuary Program

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Can Galveston Bay Fisheries Benefit from Marsh Creation?

Roger J. Zimmerman, Thomas J. Minello
Timothy Baumer, Mark Pattillo and Marie Pattillo
National Marine Fisheries Service, Galveston Laboratory

Introduction

The loss of estuarine wetlands is detrimental to many important fisheries because of the loss of essential nursery functions provided by these habitats (Boesch and Turner 1984, Minello and Zimmerman 1991). In Galveston Bay, 21% of the tidal marshes and 70% of the submerged aquatic vegetation has been lost since the 1950's (White et al. 1993). These wetland losses are continuing and are likely to accelerate with higher rates sea level rise. The resulting decline of high quality nursery area will almost certainly affect fisheries such as penaeid shrimps, blue crab, spotted seatrout, red drum, southern flounder and others. Among the few options available to offset effects of wetland loss on fisheries is creation of new habitats to replace those lost. One means of creating intertidal wetlands is through use of clean dredge material.

Our purpose was to examine the potential for biological gains and losses from marsh creation in various parts of Galveston Bay. In conducting the study, we compared animal abundance and biomass per unit area between salt marsh (*Spartina alterniflora*) and unvegetated open bay habitats. Because these habitat types are so physically different, it was necessary to employ and intercalibrate specific sampling techniques for each habitat. Accordingly, we used a drop trap sampler in the marsh and trawls in open water (compared in Zimmerman et al. 1984). Intercalibration was performed by measuring the catch efficiencies of the gear types relative to each other. Once the data were corrected for sampling efficiency, the marsh and open water measurements were directly comparable. As far as we are aware, this was the first time that densities of aquatic fauna have been compared between intertidal marsh and deeper subtidal waters throughout in an estuarine system.

Methods

Our approach was to measure densities and biomass of aquatic fauna (particularly fishery species) at open water sites and in nearby marshes, then compare the degree of faunal utilization between these habitats among the various regions of Galveston Bay. Differences were analyzed using analyses of variances (ANOVA) in a stratified design of areas designated as cells, zones and sides of the bay. Faunal densities and biomass were used as observations. We assumed that differences in utilization between marsh and open water were indicative of potential gain or loss in productivity from marsh creation. We also assumed that under favorable circumstances the marshes created at

particular disposal sites would function similar to marshes existing in the same area. Field work was conducted in the fall of 1992 between mid-September and early October. The survey assumed no significant interaction between sites due to season. An earlier study in the bay indicated that differences in animal densities between marsh and open water do not vary significantly among locations with season (Zimmerman et al. 1990). The early fall was a good time for maximizing the number of species present in the system and for optimizing measurement of marsh utilization because tidal inundation was at a seasonal high for the year.

Results

The marsh fauna of Galveston Bay were characterized in the fall by white shrimp, brown shrimp, blue crab, grass shrimp, spotted seatrout, killifishes and gobies. In open water the fauna were characterized by mysids, bay anchovies and Atlantic croaker.

The lower parts of the bay and the eastern side had the highest abundance of marsh fishes and crustaceans, and the greatest differences in abundance between marsh and open water habitats (Figures 1 and 3). The western side of the bay had larger fish sizes (Figure 2) and the least difference in fish abundance (Figure 1) between marsh and open water. The lower bay marshes had greatest numbers of brown shrimp, white shrimp and spotted seatrout. The least numbers of marsh fishes and crustaceans occurred in the upper bay along barren shorelines near Seabrook, LaPorte and in the western part of Trinity Bay. The most abundant open water fishes, including bay anchovy and Atlantic croaker, were in the Houston Ship Channel and the Trinity delta areas. Mysids were more abundant in open water in both the upper and lower bay. Blue crabs were evenly distributed throughout the bay, but highly associated with marsh habitat .

Conclusions

In most instances, the abundance and biomass of crustaceans and fishes were significantly higher in salt marshes than in open water habitats (Figures 1,2, 3 and 4). This implies that a net gain may be achieved in secondary productivity through marsh creation. The lower and eastern parts of Galveston Bay appear to have the best chance for success in marsh creation based upon highest abundance and biomass of marsh fauna and largest differences between marsh and open water. These areas incorporate large marshes already existing in East Bay and Trinity Bay. Marshes created along barren shorelines in the upper western areas of the bay would achieve much less comparative biological gain. These are areas of apparent erosion and the risk of failure for establishing new marsh may be high. In addition, the western bay supports the highest abundances of open water fauna.

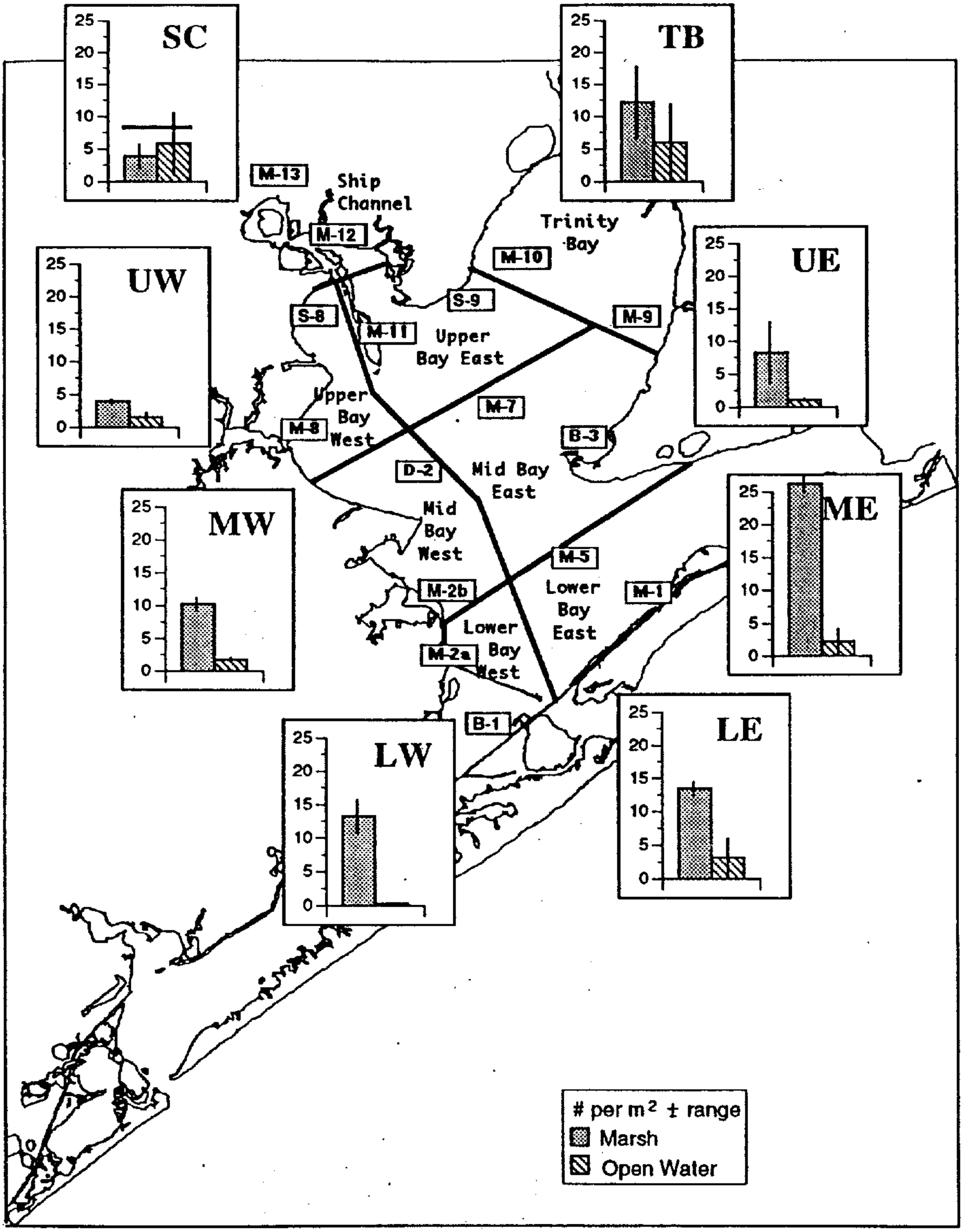

Figure 1. Mean cell densities of all fishes: Galveston Bay marsh and open water survey (Sept. 17 to Oct. 8, 1991).

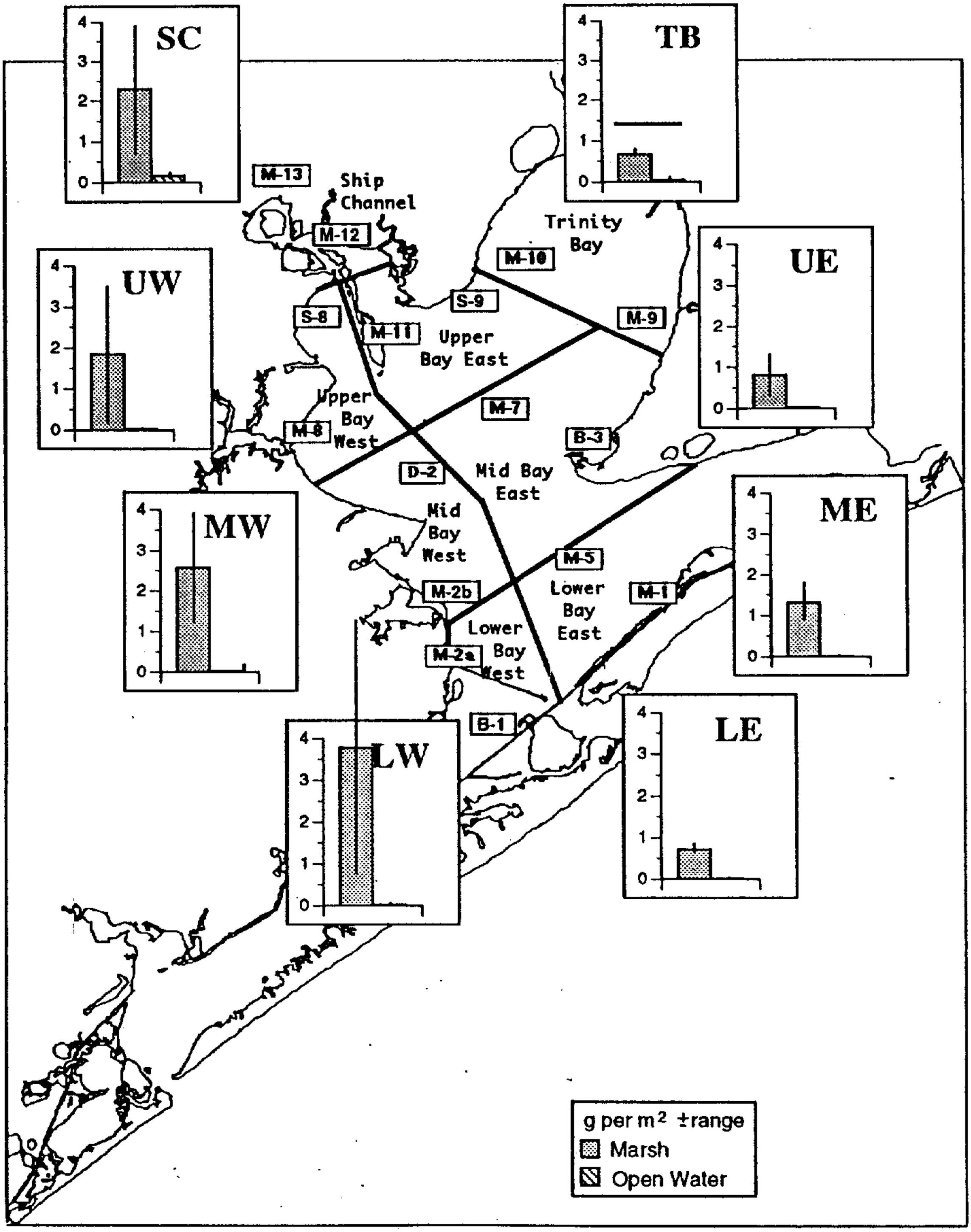

Figure 2. Mean cell biomass of all fishes: Galveston Bay marsh and open water survey (Sept. 17 to Oct. 8, 1991).

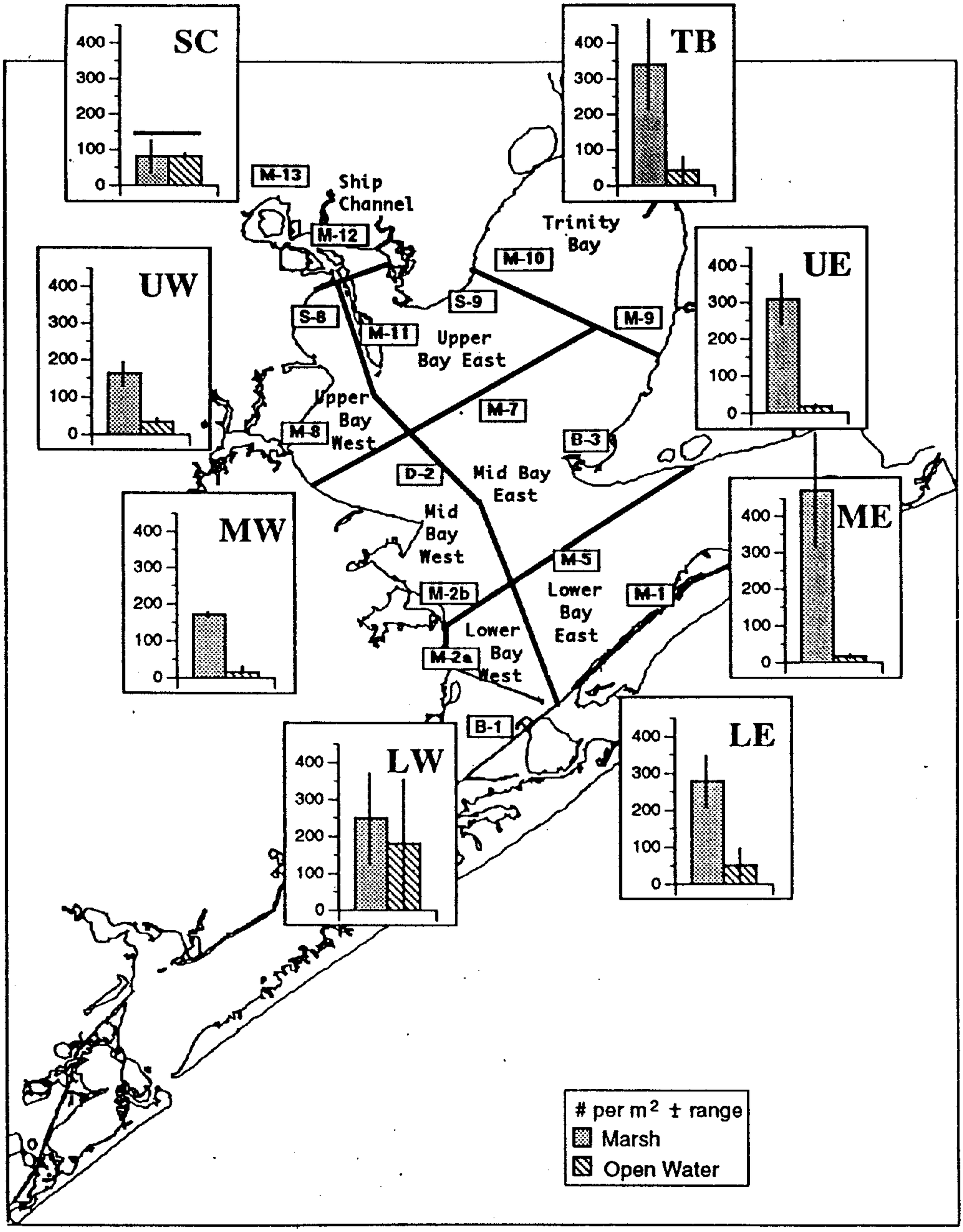

Figure 3. Mean cell densities of all crustaceans: Galveston Bay marsh and open water survey (Sept. 17 to Oct. 8, 1991).

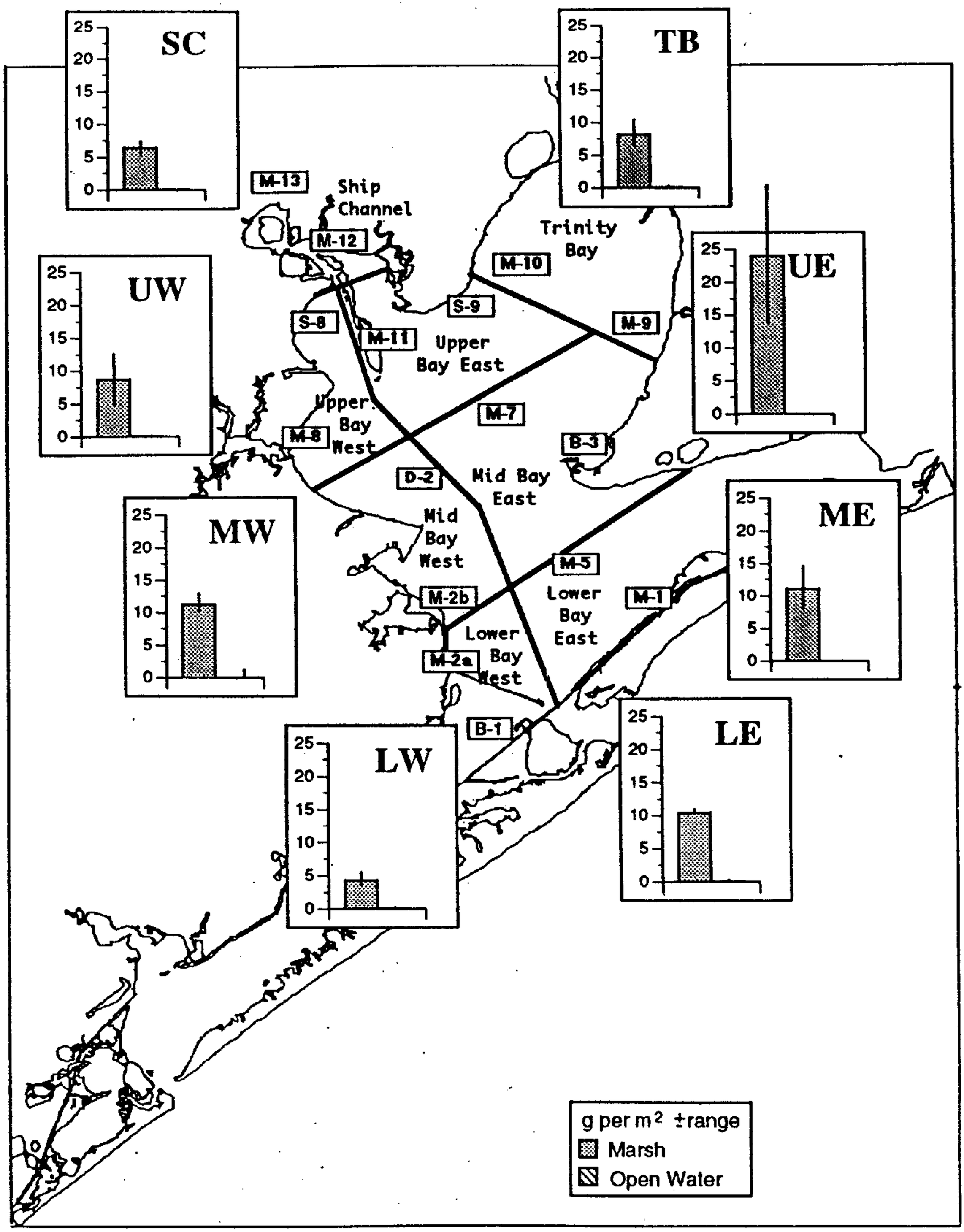

Figure 4. Mean cell biomass of all crustaceans: Galveston Bay marsh and open water survey (Sept. 17 to Oct. 8, 1991).

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